# "EFFECTIVENESS OF CONCEPT MAPPING ON ACADEMIC ACHIEVEMENT IN CHEMISTRY OF SECONDARY SCHOOL STUDENTS IN RELATION TO COGNITIVE, CRITICAL AND LOGICAL THINKING ABILITY"

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## I.INTRODUCTION

Learning and how to learn is the major issue in any educational institutions. Most teachers are searching teaching and learning strategies to overcome from this issue and help students to gain meaningful learning. Papert (1993) believes that "better learning will not come from finding better ways for the teacher to instruct but from giving the learner better opportunities to construct". Among the many techniques available, concept mapping as an effective tool for organizing new information and integrating it with the existing knowledge can provide learners opportunities to learn and construct knowledge (Gao,et al.'2007;Noval & Canas,2006).

Concept map was developed by Novak in 1972 as a tool to represent students understanding of science concepts. Concept mapping as a way to facilitate the understanding of theories and the internalization of concepts, challenging the traditional methods of rote memorization and passive learning (Kostovich et al., 2007).

### 1.1 Meaning of concept mapping.

Concept maps are visual representations of information. They can take the form of charts, graphic organizers, tables, flowcharts, Venn Diagrams, timelines, or T-charts. Concept maps are especially useful for students who learn better visually, although they can benefit any type of learner. They are a powerful study strategy because they help you see the big picture: by starting with higher-level concepts, concept maps help you chunk information based on meaningful connections. In other words, knowing the big picture makes details more significant and easier to remember.

Concept maps works very well for classes or content that have visual elements or in times when it is important to see and understand relationships between different things. They can also be used to analyze information and compare and contrast.

## 1.2 Meaning and types of Cognitive Thinking ability.

Cognitive ability refers to the ability of the human brain to process, store, and extract information, including attention, memory, and reasoning ability. It is a key psychological element for people to successfully complete an activity (Sternberg and Sternberg, 2009). Cognitive ability is currently one of the most researched and stable predictors of academic performance (Stadler et al., 2016).

There are five common domains of functions:

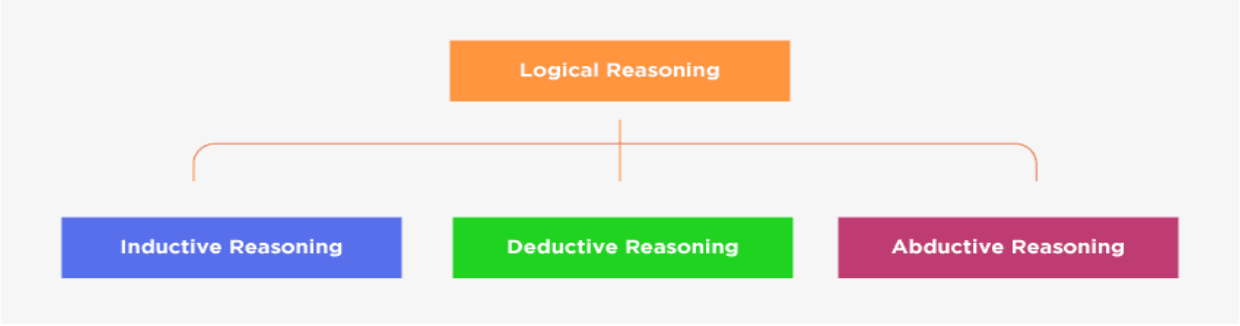
1. Episodic memory
2. Speed-attention-executive
3. Visuospatial ability
4. Fluency
5. Reasoning.

## 1.3 Meaning of Logical thinking ability:

Logical thinking defined as the act of analyzing a situation and coming up with a sensible solution. Logical thinking uses reasoning skills to objectively study any problem, which helps make a rational conclusion about how to proceed.

### Components of Logical Thinking:

When someone asks you what is the meaning of logical thinking is, your answer should be emotional reasoning and intelligence. It means you possess self-awareness of your feelings and prevent them from affecting your decision-making process.



**1. Inductive Reasoning**

Inductive reasoning or induction enables you to think more logically and rely on generalizations. Your general notions depend on anecdotal experiences, facts, and personal observations of your life that are either

**2. Deductive Reasoning**

Deductive Reasoning or Deduction is a significant component of logical thinking that seeks to reach specific conclusions. The process makes it easier for you to gain a simplified understanding and indulge in rational and logical thought processes.

## 1.4 Meaning of Critical thinking ability:

Critical thinking is the analysis of available facts, evidence, observations, and arguments in order to form a judgments by the application of rational, skeptical, and unbiased analyses and evaluation. The list of core critical thinking skills includes observation, interpretation, analysis, inference, evaluation, explanation, and metacognition. According to Reynolds (2011), an individual or group engaged in a strong way of critical thinking gives due consideration to establish for instance

- Evidence through reality
- Context skills to isolate the problem from context
- Relevant criteria for making the judgment well
- Applicable methods or techniques for forming the judgment
- Applicable theoretical constructs for understanding the problem and the question at hand

## 1.5 Need and Significance of concept mapping in Chemistry:

Chemistry is a complex subject because it is integrated with other fields like Maths and physics to understand fully. Most students find it hard to study chemistry since it contains a vast amount of unfamiliar topics. Aside from that they have to memorize terms, Formulas, Reaction and concepts. To reduce the complexity of learning Chemistry, concept mapping plays a very important role.

- Enables learner to process, understand and store extensive information easily.
- Gives visual representation of the different Chemistry concepts and how they are interconnected with each other.
- It allows students to challenge their logical thinking and build a better understanding of Chemistry.
- It helps students track what concepts of Chemistry they know and do not.
- It also helps to identify the concepts need to review.
- Make easy to learn the complex topics.
- Helps to make quick revision of topics at the time of examination and ensure that the learner retain the information after the examination also.

**1.6 Objectives of the study**:

The following are the objectives framed for the present study.

1) To study the significance difference between pre-test and post-test achievement in Chemistry of 9$^{th}$ standard students of secondary school of both control and experimental groups.
2) To study the significance difference between pre-test and post-test cognitive ability in Chemistry of 9$^{th}$ standard students of secondary school of both control and experimental groups.
3) To study the significance difference between pre-test and post-test critical thinking ability of 9$^{th}$ standard students of secondary school of both control and experimental groups.
4) To study the significance difference between pre-test and post-test logical thinking ability of 9$^{th}$ standard students of secondary school of both control and experimental groups.
5) To compare the significant difference between traditional method of teaching and concept mapping method with respect to post test scores of academic achievement in Chemistry 9$^{th}$ standard students.

### 1.7 Delimitations of the study:

1) The study is limited to IX standard students only
2) The study is limited to Karnataka state only
3) The study is limited to Vijayapur city only
4) The study is limited to English medium students only
5) The study is limited to Variables cognitive, critical and logical thinking ability and achievement in Chemistry only.
6) The study is limited to the subject Chemistry only.
7) The study is limited to evaluate the effect of concept mapping method on IX standard students compared to conventional method.
8) The study is delimited to moderate variable Gender.

## II. Review of Related Literature

**1. Singh Deveshi (2021) Effectiveness of concept mapping in terms of achievement and concept Retention in biology among higher secondary students.** According to researcher concept mapping is very successful means to make learner construct their knowledge by own and teacher as guide. It is based on the Ausubel's meaningful learning. Mostly they used experimental / quasi experimental method for higher secondary school students. The purpose of this study is to investigate the effectiveness of two teaching methods namely concept mapping method and conventional method in teaching learning process. The objectives of research is to study the effectiveness of concept mapping method in comparison to the conventional method in terms of achievement in biology of higher secondary school

To study the concept retention in biology of higher secondary school students being taught through concept mapping as compare to conventional method. Population of the study is higher secondary science students studying in English medium CBSE School in Varanasi city. Sample of the study is Class XII students, central boys Hindu school Varanasi by multiphase random sample. Researcher prepared two groups one is experimental (concept mapping method) and other is Conventional method. Dependent variable is Achievement of the students on the biology, criteria reference test, Achievement; concept retention was taken as dependent variable. Intelligence, gender and teacher as

dependent variable. Tools used in this research are Intelligence test, Concept difficulty rating scale and Biology criterion referenced test. Four stages in Experimental method were followed, Pre-treatment, treatment, post treatment and delayed post treatment. In statistical analysis Descriptive statistics (Mean, Median, mode, kurtosis, skewness, Standard Deviation, Variance, co-relation) and Inferential statistics (ANOVA, ANCOVA, AND T-TEST) are used. The findings of the research is that Concept mapping as teaching method is significantly more effective than conventional method not only in improving achievement but also helps in retaining the learned concepts of biology. Curriculum development, Quick review at the end is some of the educational implications of this research.

**2.Pandey Deepika (2019) Effectiveness of concept attainment and concept mapping teaching strategies for teaching biology to class IX students.** The objectives of their study is to investigate the effectiveness of concept mapping teaching strategy for teaching biology to investigate the effectiveness of concept attainment teaching strategy for teaching biology to compare the effectiveness of Concept Mapping, Concept attainment and teaching strategies of teaching biology. Research hypotheses states that Pre-test and post-test scores of student exposed to Concept attainment teaching strategy differs. Delimited to class IX students in prayagraj city, 38 periods are for experimental group. Two schools were taken (boys and girls) Samples are collected through cluster sampling technique and collected 310 students. The experimental design was non equivalent group, pretest post test quasi experimental design, Intelligent and personality traits 3x2 traits pictorial design has been used. Concept mapping, concept attainment and traditional teaching strategies as independent variable. Dependent variable as Personality traits and intelligence has been considered as intervening variable. Biology achievement test developed by researcher used as a tool to measure achievement in biology. Neo personality questionnaire constructed by KS mishra to measure different personality traits of students. Culture fair intelligence test scale 3, Form A, constructed by R.B. Catell and A.K.S Catell to measure intelligence. T test and ANOVA are the statistical techniques use in the research. Research finds concept mapping teaching strategy and concept attainment teaching strategy is

effective for teaching biology to boys and girls. Research has educational implication as it gives meaningful learning and transformation of learning environment. Researcher suggested to other investigator as further researches can be done in different subjects, variables like scientific thinking, attitude towards science, formal reasoning influence the effectiveness of concept mapping as also effective tool of evaluation.

**3. Sindhu.V (2019) Effectiveness of concept mapping instructional package on achievement in chemistry and problem solving ability of secondary school students.** The objectives of above study are, to develop and validate Concept mapping instructional package in teaching chemistry for secondary school students to develop and validate achievement test in chemistry for secondary school students. The current study is delimited to only chemistry, 8$^{th}$ slandered and measures in terms of only achievement and problem solving. Study is delimited to concept mapping as teaching tool only. Randomly they collected 8$^{th}$ standard students from R.T.Nagar, Bangalore. Researcher developed and validated concept mapping instructional package and chemistry achievement test for 8$^{th}$std students. Problem solving ability test PSAT developed by L.N.Dubey (2011) Culture fair intelligence test of RB Catell and A.K.S Catell (1999) for present study. For statistical analysis ANOVA (One way and two way), T-test, Mean, Slandered Deviation. This research found that Concept Mapping Instructional Package is more effective than traditional method of teaching in the improvement of achievement and enhancing the problem solving ability among secondary school students. The research suggested that further research can be done as concept mapping as learning tool, used in the other subjects like physics, biology.

## Conclusion

The survey of related literature guide the researcher to frame hypothesis, objectives, selecting different Components of tools, idea to conduct research, number of sample to be taken etc. The researcher carried on the present study on the basis of the above mentioned related literature, hoping that the present study will be of great help to get meaningful learning among learner.

## III: DESIGN OF THE STUDY:

### 3.1 Statement of the Problem:

*"Effectiveness of Concept mapping on Academic achievement in Chemistry of Secondary school students in relation to cognitive, critical and logical thinking ability".*

### 3.2 Variables used in the Present Study:

The investigator considered two major types of variables, viz., independent and dependent

| Type of Variable | Variable considered |
|---|---|
| Independent Variable | ➢ Concept Mapping |
| Dependent Variable | ➢ Achievement in Chemistry<br>➢ Cognitive Thinking Abilities<br>➢ Critical thinking Abilities<br>➢ logical thinking Abilities |
| Moderate Variables | ➢ Gender |

### 3.3 Hypothesis of the study.

The following research hypothesis is framed for the present study.

1) There is significance difference between pre-test and post-test achievement in Chemistry of 9$^{th}$ standard students of secondary school with respect to experimental group.
2) There is significance difference between pre-test and post-test cognitive ability in Chemistry of 9$^{th}$ standard students of secondary school with respect to experimental group.
3) There is significance difference between pre-test and post-test critical thinking ability of 9$^{th}$ standard students of secondary school with respect to experimental group.
4) There is significance difference between pre-test and post-test logical thinking ability of 9$^{th}$ standard students of secondary school with respect to experimental groups.

5) There is significant difference between traditional method of teaching and concept mapping method with respect to post test scores of academic achievement in Chemistry 9th standard students.

### 3.4 Methodology of the Study:

The investigator felt that the Experimental method would be the most appropriate one to study. **Quasi Experimental** design will be used as whole, and class 9th students will be considered as control and experimental group.

**Experimental Design:**

Pre-test and post-test, Quasi Experimental group design

| *Experimental Group* | *Control Group* |
|---|---|
| Pre-test -Treatment -Post-test | Pre-test –No Treatment -Post-test |
| Teacher Developed concept mapping | Conventional Method of Teaching with 5 E's |

### 3.5 Sampling Techniques:

***Population and Sample:*** The population of the study will be all English medium class 9th standard students in Bijapur district. In this study Random stratified sampling technique will be used to draw sample from the population.

The present study would be conducted on 100 students of 9th standard.

| Experimental group | | Controlled group | |
|---|---|---|---|
| Boys -25 | Girls – 25 | Boys -25 | Girls – 25 |

### 3.6 Tools for the study:

Following tools will be used in the study

- Achievement test(Developed by Investigator)
- A profile will be prepared by the researcher for collection of information about past achievement of the students for classification of student according to their abilities

- Montrial cognition Assessment test for cognition
- Critical thinking ability test will be developed by Investigator
- Logical thinking ability test will be developed by Investigator

**3.7 Statistical Techniques to be used**:

The following statistical techniques will be used for analysis of data.

- Descriptive statistics(Mean and Standard Deviation)
- Differential or inferential statistics t' test.
- One way, 2 way and 3 way ANOVA test
- Correlation analysis
- Regression analysis techniques will be used for finding the determinant variable for achievement.

**3.8 References:**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